Stacking & LSM Namespacing Redux

Linux Plumbers Container MC 2018

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Linux Security Modules (LSM)

- Provide security
- Often MAC but not necessarily
- Kernel provides security
  - Hooks
    - Located at security decision points
    - All security relevant info available
    - Race free
  - Security field in various objects

- selinux, smack, apparmor, tomoyo, IMA/EVM, loadpin, yama
- proposed: LSMs: LandLock, CaitSith, Checmate, HardChroot, PTAGS,
  SimpleFlow, SafeName, WhiteEgret, shebang, S.A.R.A.

Use Cases

- LSM enabled in container but not on Host
  - ChromeOS running Android SELinux container
  - Virtual smart phone env (Cells/Cellrox), multiple android instances
  - Thin linux host (clear linux)
- system container
  - lxd. run Ubuntu (apparmor) container on rhel (selinux) host
- application confinement
  - snap using apparmor running on fedora (selinux base system)
  - Docker
  - flatpak

Problem

The LSM is not Namespaced

LSM Namespacing

- Just Create an LSM Namespace!
- Presented & Discussed idea at Linux Plumbers 2017
  - Not enough semantic info at LSM layer
  - Some LSMs don’t want to be “namespaced”
    - Want to bound container
    - No generic Solution
  - Real work needs to be done in security modules

Namespacing the LSMs

Requirements

- Not every LSM has the same requirements
- System level confinement (confine the container)
  - eg selinux using MCS label per container
  - do NOT want either OR mediation
    - ie. selinux mediating tasks outside
    - container using different LSM not confined by selinux
- Application level confinement
  - Not every LSM supports
- Dependent Components Need support (audit, ...)

Audit

- Want ContainerID
  - But …
- Dependency of LSMs (apparmor, selinux, smack, ima)
- Not Namespaced
- Single Set of Rules
- Single daemon registration

Audit LSS16: Conclusion

- Auditd ok with MNT, UTS, IPC, CGRP ns
- NET ns ok for now
  - Will need audit_pid/portid per USER ns
- PID ns ok for now for audit user messages
  - Will need translation per PID ns
- Auditd per USER ns wanted for containers
- NamespaceID vs. Audit ContainerID
- Need audit log aggregation by container orch

AuditID

- U64
- containers can't be universally identified by namespace (sub)set
- audit daemon won't be tied to any namespace
- netNS needs list of possible IDs responsible for net events
- child inherits parent's ID
- allow multiple audit daemons
  - each will have its own queue and ruleset
  - auxiliaries can't influence host

SELinux NS

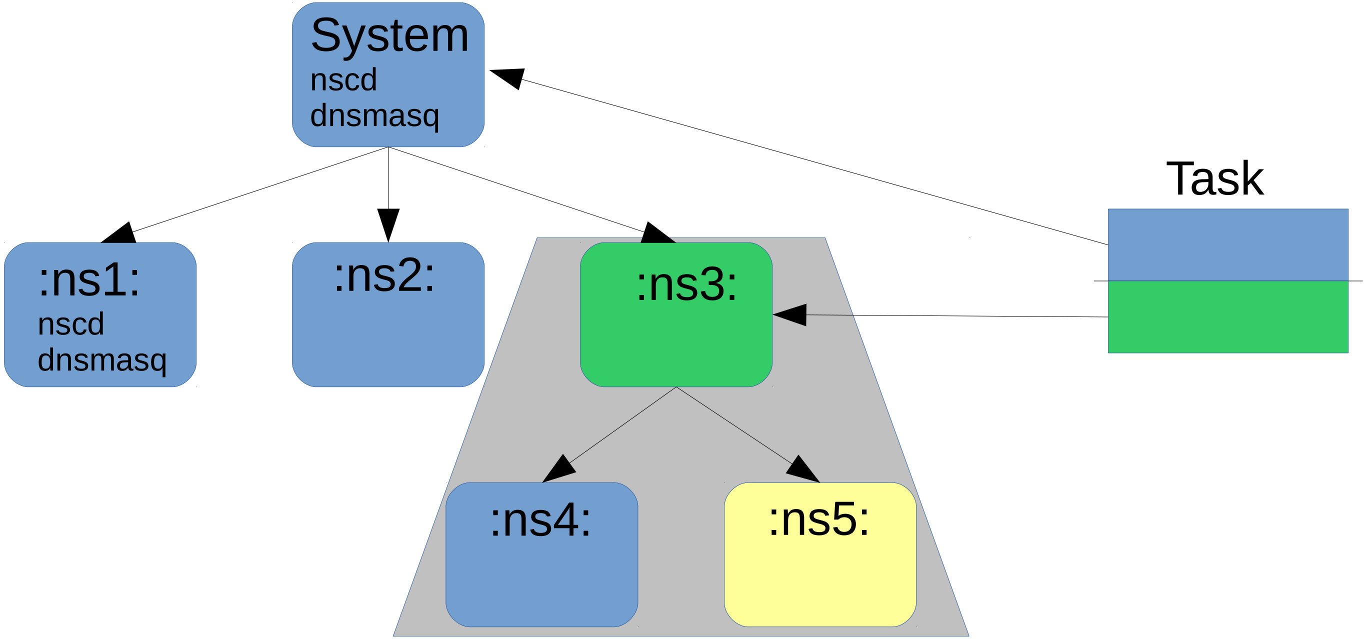
- Adds per-namespace selinuxfs instances
  - unshare mount ns and mount new selinuxfs
- Move AVC into namespace
- Add per-namespace support for kernel objects
- Write to selinuxfs unshare node to instantiate
- On Disk Inodes store all each NS label
- NS
  - Track nesting
  - Bounded enforcement

SELinux prototype

```
echo 1 > /sys/fs/selinux/unshare
unshare -m -n
umount /sys/fs/selinux
mount -t selinuxfs none /sys/fs/selinux
load_policy
runcon unconfined_u:unconfined_r:unconfined_t:s0:c0.c1023 /bin/bash
setenforce 1
```

AppArmor

- Namespaced
- Stacked
- Virtualized fs



AppArmor Problems

- Namespacing
  - mount, network, user, .. pita
    - Need more infrastructure
- Securityfs
  - can’t mount multiple instances need to bind mount
- Still only AppArmor in AppArmor containers

IMA

- Really wants ContainerID
- Prototype
  - IMA Audit
  - Virtualized IMA fs interface
- EVM
  - Problems with ns xattr storage

Other LSMs

- Smack
  - Prototype namespace from a few years ago
- Yama
- Loadpin

- Landlock
- Sara

Stacking the LSMs

Stacking Enablement

- LSMs enabled at boot
  - Reserve space for kernel objs
  - Infrastructure manages life time
  - Register hooks
- New kernel param
  - LSM=

Making Stacking Work

Problem

- Userspace Interfaces
  - /proc/pid/attr/*
  - SO_PEERSEC

Fix

- Virtualize – per task default LSM

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- Interface to set default LSM

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Fix

- Virtualize – per task default LSM
- Interface to set default LSM
- New versions of interfaces
  - /proc/pid/attr/apparmor/*
  - /*proc*/pid/attr/smack/*
- …

Making Stacking Work

Problem

- Userspace Interfaces
  - /proc/pid/attr/*
  - SO_PEERSEC
- Networking
  - secids

Fix

- Virtualize – per task default LSM
- Interface to set default LSM
- New versions of interfaces
  - /proc/pid/attr/apparmor/*
  - /*proc*/pid/attr/smack/*
- …
  - Dynamically compose & remap

Making Stacking Work

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- Userspace Interfaces
  - /proc/pid/attr/*
  - SO_PEERSEC

- Networking
  - secids
  - secmark

Fix

- Virtualize – per task default LSM
- Interface to set default LSM
- New versions of interfaces
  - /proc/pid/attr/apparmor/*
  - /*proc*/pid/attr/smack/*
- …

  - Dynamically compose & remap
  - Extend to support multiple LSMs

Making Stacking Work

Problem

- Userspace Interfaces
  - /proc/pid/attr/*
  - SO_PEERSEC

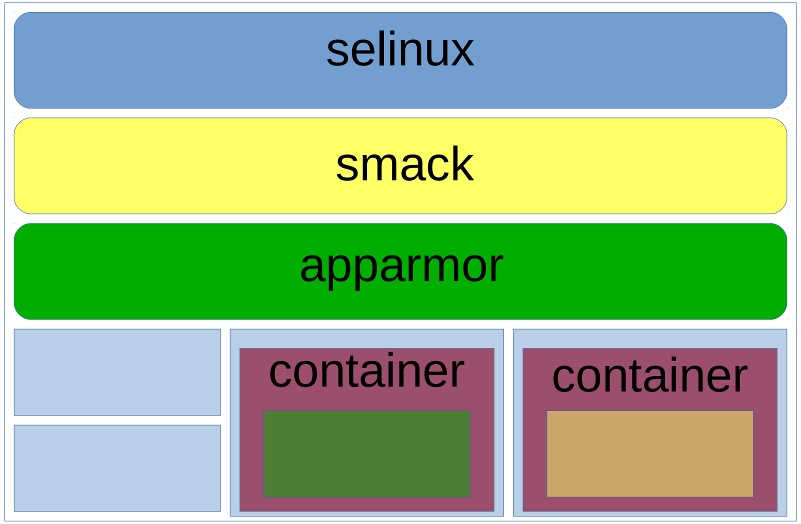
- Networking
  - secids
  - Secmark
  - Netlabel cipso/calypso/xfrm

Fix

- Virtualize – per task default LSM
- Interface to set default LSM
- New versions of interfaces
  - /proc/pid/attr/apparmor/*
  - /*proc*/pid/attr/smack/*
- …

  - Dynamically compose & remap
  - Extend to support multiple LSMs
  - Only 1 LSM may claim and use

Current Situation with Stacking



References & Thanks

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Overview and Recent Developments: AppArmor
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